ROCKY FLATS PLANT, PLUTONIUM FABRICATION
(Building 776/777)
Central section of the Plant
Golden vicinity
Jefferson County
Colorado

HAER No. CO-83-O

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

ROCKY FLATS PLANT,
PLUTONIUM PROCESSING FACILITY HAER No. CO-83-O
(Rocky Flats Plant, Building 776/777)

Location: Rocky Flats Environmental Technology Site, Highway 93, Golden, Jefferson County, Colorado. Building 776/777 is located in the central section of the Rocky Flats Plant (Plant).

Date of Construction: 1956.

Fabricator: Catalytic Construction Company, Philadelphia, Pennsylvania.

Present Owner: United States Department of Energy (USDOE).

Present Use: Plutonium Weapons Component Production and Recovery.

Significance: This building is a primary contributor to the Rocky Flats Plant historic district associated with the United States (U.S.) strategy of nuclear military deterrence during the Cold War, a strategy considered of major importance in preventing Soviet nuclear attack. In 1957, a new trigger design resulted in an increase in the amount of plutonium required to build a trigger. As a result of design changes and corresponding increases in workload, the Building 776/777 complex was constructed. Beginning in 1958 and continuing through 1969, Building 776/777 was the main manufacturing facility for plutonium weapons components. Building 776/777 reflected the latest design criteria and engineering technology available at the time of construction.

Historians: D. Jayne Aaron, Environmental Designer, engineering-environmental Management, Inc. (e^2M), 1997. Judith Berryman, Ph.D., Archaeologist, e^2M, 1997.

Project Information:

In 1995, an inventory and evaluation were conducted of facilities at the Plant for their potential eligibility for listing in the National Register of Historic Places. The primary goal of this investigation was to determine the significance of the Cold War era facilities at the Plant in order to assess potential effects of the long-term goals and objectives of the USDOE. These goals and objectives include waste cleanup and demolition. Recommendations regarding National Register of Historic Places eligibility were developed to allow the USDOE to submit a formal determination of significance to the Colorado State Historic Preservation Officer for review and concurrence, and to provide for management of historic properties at the Plant.

From this determination and negotiations with the Colorado State Historic Preservation Officer, the Advisory Council, and the National Park Service, a Historic American Engineering Record project began in 1997 to document the Plant's resources prior to their demolition. The Plant was officially listed on the National Register of Historic Places in 1997. The archives for the Historic American Engineering Record project are located in the Library of Congress in Washington, D.C.

Introduction:

The Plant is one of thirteen USDOE facilities that constitute the Nuclear Weapons Complex, which designed, manufactured, tested, and maintained weapons for the United States arsenal. The Plant was established in 1951 to manufacture triggers for use in nuclear weapons and to purify plutonium recovered from retired weapons. The trigger consisted of a first-stage fission bomb that set off a second-stage fusion reaction in a hydrogen bomb. Parts were formed from plutonium, uranium, beryllium, stainless steel, and other materials.

A tense political atmosphere both at home and abroad during the Cold War years drove U.S. weapons research and development. By the 1970s, both the U.S. and the Soviet Union maintained thousands of nuclear weapons aimed at each other. These weapons were based on submarines, aircraft, and intercontinental ballistic missiles. Both the North Atlantic Treaty Organization and Warsaw Pact countries in Europe had small nuclear warheads called theater weapons used as part of the Mutually Assured Destruction program. (The Mutually Assured Destruction program acted as a deterrent in that if one side attacked with nuclear weapons, the other would retaliate and both sides would perish.) The final nuclear weapons program at the Plant was the W-88 nuclear warhead for the Trident II missile. This mission ended in 1992 when President Bush canceled production of the Trident II missile.

The Plant was a top-secret weapons production plant, and employees worked with a recently man-made substance, plutonium, about which little was known concerning its chemistry, interactions with other materials, and shelf life. The Historic American Engineering Record documentation effort focuses on four aspects of the Plant and its role in the Nuclear Weapons Complex: manufacturing operations; research and development; health and safety of workers; and security.

Chronology of Building 776/777:

1957 Construction of Building 776/777 was completed. The 776 side contained plutonium components manufacturing, and the 777 side housed assembly and inspection of triggers for nuclear weapons. A wall separated the two sides of the building.

1960 The first significant machining of plutonium began.

1962 The concrete block wall between the two sides of Buildings 776/777 was removed to accommodate additional equipment.

1964 The Campbell Incident occurred involving an explosion between plutonium and carbon tetrachloride in Building 776/777 in a briquetting operation. This incident resulted in research and development projects that examined the interaction of plutonium with a variety of solvents.

1965 A fire in the glove box drain line occurred during maintenance on a plugged oil coolant drain line. The fire was attributed to spontaneous combustion of plutonium chips.

1966 The canteen, locker room, and laundry were relocated to another building in order to provide more operating space in Building 776/777.

1969 A major fire occurred in Building 776/777 on May 11 when a plutonium briquette spontaneously ignited. Plutonium fabrication processes were relocated due to radioactive contamination caused by the fire. Many new safety features were developed to control and prevent plutonium fires.

1969 Waste operations began in Building 776/777 for the purpose of disposing of materials contaminated by the 1969 fire.

1970 Pyrochemical operations used for plutonium recovery began in Building 776/777.

1971 Clean-up activities for the 1969 fire were completed on October 18.

1972 Plutonium fabrication operations were transferred to Building 707. Building 776/777 was converted to a waste storage and size reduction facility.

1979 The two-story, 3,000-square-foot trash compactor, officially known as a fluidized bed incinerator, made its first 108-hour burn of non-production-generated, low-level, transuranic waste. It brought to a close nine years of research and development spent on the project.

1983 Construction began on the Advanced Size Reduction Facility.

1986 The Advanced Size Reduction Facility became operational.

1988 A new hot laundry facility began operations to launder radionuclide-contaminated clothing separately from non-contaminated Plant laundry.

Building History:

In 1957, a new trigger design resulted in an increase in the amount of plutonium, relative to uranium, that needed to be processed at the Plant. In addition, different shapes of plutonium with closer dimensional tolerances were required. Thus, more rolling, forming, and machining of plutonium was required than in the earlier years of weapons production. As a result of these design changes and corresponding increases in workload, the Building 776/777 complex was constructed for plutonium casting, fabrication, and assembly, and for quality assurance testing.

Beginning in 1958 and continuing through 1969, Building 776/777 was the main manufacturing facility for plutonium weapons components and housed foundry and fabrication operations. Building 776/777 reflected the latest design criteria and engineering technology available when it was constructed. Since the facility was first occupied in 1957, ten major modification additions were made to update the building and/or to provide increased safety.

On May 11, 1969 at 2:27 p.m., a fire was detected in Building 776/777 when an alarm in the north plutonium foundry glove box line was triggered. Spontaneous ignition of a briquette of scrap plutonium alloy metal contained in a small metal can caused the fire. The fire spread through combustible materials in up to 150 connecting glove boxes in Building 776 and the assembly line in Building 777. The fire was brought under control by 6:30 p.m. Fearing a breach in the building's outer walls, firefighters used water to control the blaze. This was the first time water was used directly on burning plutonium and it did not create a nuclear criticality. Because of their efforts, fire department personnel received a Group Presidential Citation for heroism for risking their own health and well being to prevent a breach of the building, thus preventing plutonium contamination in the atmosphere and offsite.

No serious injuries occurred in the fire, although one firefighter inhaled a measurable amount of plutonium and thirty-two employees were treated for contamination. Scientists estimated an atmospheric plutonium release of approximately 0.000012 grams (0.0002 curies); all of it contained on plant site. There were no immediate health effects to persons offsite. The operating areas in Building 776/777 suffered extensive damage, resulting in $26.5 million in property loss. Decontamination took two years to complete. The incident resulted in significant safety improvements in glovebox operations including installation of water sprinklers and firewalls to control the spread of fire, and the use of inert atmospheres for plutonium operations to prevent spontaneous ignition. (Rockwell International, press release 11/85)

After the fire, the majority of the foundry and fabrication operations were transferred to Building 707. After several months of clean-up, limited production operations resumed in Building 776/777. The main operations conducted in the building became waste and residue handling, although operations such as disassembly of site returns (nuclear weapons shipped to the Plant from the nuclear weapons stockpile for retirement, upgrade, or reprocessing) and special projects continued in the building as well. Processes conducted in the building included size reduction of contaminated glove boxes and miscellaneous large equipment volumes for waste disposal, pyrochemistry, coating operations, and test runs of a fluidized bed incinerator unit.

Building Description:

Building 776/777 is located in the north-central section of the Plant, south of Building 771 and north of Building 707. It is constructed primarily of structural steel covered with transite. Interior walls are of concrete block or structural steel and transite. Some vault areas are poured, reinforced concrete. The poured concrete radiographic vault is part of the north outside wall of Building 776/777. The original roof is structural steel under flat metal decking, with poured insulating concrete over the decking. The final seal is built-up asphalt. A second roof was added above the original in 1972 to provide a better seal. The new roof is on a tapered structural steel frame and metal decking overlain with insulating concrete and built-up composition roofing. There are no windows in the building.

Building 776/777 is a two-story structure, with a partial basement. The main floor occupies 135,000 square feet. The second floor contains 88,000 square feet, and is almost exclusively occupied by utilities. The basement occupies 1,600 square feet.

Since 1957, ten major modifications and additions have been completed including the Building 777 addition; an x-ray vault; a compressor house; a radiography area; a cleaning and plating facility; fabrication, maintenance, and storage areas; an assembly plant; an autoclave facility; an inert surveillance and assembly development area; and a betatron vault. Total floor area of the complex is 156,200 square feet. The x-ray vault has 4'-thick reinforced concrete walls, and the betatron vault has 7'-6"-thick reinforced concrete walls. Various additions to Building 776/777 have 8"-thick concrete block walls. Other additions to Building 776/777 have galvanized steel wall panels.

Prior to the 1969 fire, the majority of the building space was in one large open room. Since that time, the main floor of the building has been compartmentalized into four areas (Areas 1 – 4), separated by physical barriers to confine radioactive material releases and contain the spread of fire. Each area is further divided into rooms or functional areas, and within the rooms or functional areas, plutonium processing equipment is contained in glove boxes or process storage vaults. The purpose of these enclosures within enclosures was to contain radioactive material and keep exposure to personnel as low as practicable.

Area 1 is located in the north part of the 776 section of Building 776/777. This area houses a controlled maintenance area, compressor room, size reduction facility, demonstration plant for fluidized-bed incineration, and drum storage area.

Area 2 is located in the southwest part of the 776 section of Building 776/777. Located in this area are the advanced size reduction facility, a pilot plant for fluidized-bed incineration, pyrochemical operations, metallurgical operations and fabrication/inspection, the west dock, and offices.

Area 3 is located in the north and east parts of the 777 section of Building 776/777. This area houses a non-destructive testing facility, a coatings operation, production control, special assembly, physical testing, a dock area, and a drum storage area.

Area 4 is located in the southwest part of the 777 section of Building 776/777. This area contains inspection, gas sampling, training, and drum storage areas, a super-dryroom, the women's locker room, and the south dock.

The second-floor of Building 776/777 has one main area above the 776 section of the building. Two north-south fire walls, one toward the west end and the second near the center of the second floor, and the primary exhaust high-efficiency particulate air filter plenum, which runs east to west, divide this main area of the second floor into four compartments. This area is dedicated to building utilities and heating, ventilating, and air conditioning equipment. There are two smaller areas over the northwest additions to the 777 section of the building which provide office space and space for filter plenums.

The basement (Room 001) is located beneath the main drum storage area (Room 127) on the first floor. Access is by stairway. This room, shielded with a lead-lined door, contains four bays and is used for waste drum storage.

The major structures of the Building 776/777 complex are Building 776/777 itself, and Building 778, the laundry building. Other structures in the complex include cooling towers (Buildings 712 and 713); Buildings 702 and 703 - the pump houses for Buildings 712 and 713, respectively; and Building 701, which is a research laboratory. A tunnel connects Buildings 771 and 776. Other features of the complex are two underground process waste storage tanks with a total capacity of 54,000 gallons, and one 5,000-gallon diesel fuel underground storage tank. Electrical, water, telephone, inert gas, sanitary sewer, and fire protection utility systems serve the complex. Most of these systems are underground.

Building Operations:

Originally, Building 776/777 was the primary plutonium fabrication facility at the Plant, and operations consisted of plutonium parts casting, fabrication, assembly, inspection and testing; research and development; disassembly of site returns (weapon components returned to the site to be retired, upgraded, or reprocessed); and plutonium waste recovery. After a major plutonium fire in 1969, most of the plutonium casting and fabrication processes were transferred to another building at the Plant. After that time, Building 776/777 was dedicated primarily to plutonium waste recovery, inspection and testing, disassembly of site returns, waste handling, and special projects.

Building operations are discussed under three general time periods. The first time period covers operations in the building from 1957 to 1969, and includes only those operations that were eventually transferred to other locations. The second time period covers operations that remained and those that began after the 1969 fire, and the third identifies processes that remained active after production at the Plant ceased.

Operations from 1957 to 1969

Originally, a concrete wall divided Building 776/777 into two main areas, each with a different function. One area, the 776 section, was used primarily for casting and fabrication of plutonium parts. The other area, 777, was used for assembly of parts and some disassembly of site returns. The concrete wall dividing the building was removed in 1962.

Four principal glove box systems existed in Building 776/777 between 1957 and 1969. These included the north foundry line, the south foundry line, the center line, and the north-south-east machining line. All production operations were carried out in glove boxes which were interconnected by conveyors.

Casting Operations

The original plutonium foundry was located in the southwest corner of Building 776/777. Foundry equipment consisted of two, nearly identical glove box lines (the north foundry line and south foundry line). The foundry contained sixteen furnaces, eight in each glove box line, which were crowded into a single room. Foundry operations cast plutonium either as ingots suitable for rolling and further wrought processing or into shapes amenable to direct machining operations. A briquetting press was also contained in the north and south foundry lines where scrap plutonium metal from foundry and fabrication processes was cleaned and pressed into small briquettes. These briquettes became part of the feed materials for the foundry.

After the 1969 fire, casting operations in Building 776/777 ceased, the furnaces were moved to Building 707, and the resulting space was used for waste recovery related operations.

Fabrication Operations

Fabrication operations involved either the wrought process, which prepared an ingot for machining operations, or direct machining of ingots and cast shapes. In the wrought process ingots were rolled into sheets and cut into circular-shaped blanks to be passed through the center line for pressing. The pressed blanks were then annealed and machined. Machining involved taking the cast or wrought part and removing the excess material by contouring, drilling, and milling. Machining operations took place on the north-south-east line. Equipment was contained in eleven glove boxes, and included a dry lathe, eight oil-cooled lathes, a mill, and a jig borer.

After the 1969 fire, the south portion of the machining line in Building 776/777 resumed operations, supporting primarily special order work and one weapons program.

Assembly

Assembly operations were located in Building 776/777 and involved assembling various nuclear and non-nuclear trigger components. Activities included drilling, welding, brazing, turning, and polishing. The components primarily contained nuclear materials such as plutonium and uranium; however, components containing non-nuclear materials such as beryllium, steel, copper, monel (a metal alloy), and silver were also assembled.

Parts were cleaned prior to final assembly. After 1961, the cleaning process changed from the use of a solvent dip tank to an ultrasonic solvent unit. Final assembly took place in a super-dry room with controlled temperature, humidity, and airflow. Fabricated components were moved to the super-dry room in the downdraft assembly area to be welded. Welded assemblies were then baked, filled and sealed, leak-tested, weighed and non-destructively tested. Completed assemblies were subjected to several inspection and testing processes including radiography, dimensional inspection, and sampling. Similar operations took place for non-nuclear assemblies.

After assembly, complete units were packed and shipped off-site or to Building 991 for final processing, storage, and shipping.

After the 1969 fire, Building 707, not Building 776/777, was the main source for parts to be assembled in Building 776/777.

Operations from 1969 to 1989

Operations after the 1969 fire included testing and inspection, disassembly of site returns, special projects, plutonium recovery, waste management, and laboratory work. Although some of these operations, such as plutonium recovery and testing and inspection, also occurred before the fire, they are discussed here since the operations were expanded after the fire.

Inspection

Testing and inspection of parts was conducted in Building 776/777 at steps throughout the fabrication and assembly processes. Inspection consisted of visual inspection of components and assemblies for cracks, voids, or other imperfections, and measurement of the parts. Density balance operations were used to determine the density of plutonium metal parts. This activity, conducted in an inert atmosphere nitrogen glove box, consisted of immersing the object in a Freon 113 bath and measuring its density relative to Freon. Parts having the specified density were further processed.

Items were also weighed in a glove box on a gram balance. Final weights were compared to design specifications.

Non-destructive Testing

Non-destructive testing was conducted to examine plutonium parts for structural flaws. Radiography was the primary non-destructive testing method. Items to be tested were exposed to a radiation source to create an image of the object on film. The recorded image was evaluated with specifications for acceptance or rejection of the item. Work was completed in vaults having high-density concrete walls varying in thickness from 2 to 8'. Interlocks ensured that the equipment activated only when the vault doors were closed and the keys were removed.

Destructive Testing

Destructive testing was conducted on components at various stages throughout the fabrication process to verify component integrity. These tests included analyses of stress, tensile strength, vibration, and gravity force. There were several test systems used to make these analyses.

Stress analysis was used to pressurize a component or assembly to either preset limits or to destruction. There were several systems used for stress analysis. One hydrostatically operated system generated a pressure of 100,000 pounds per square inch. Although the manufacturer certified the system plumbing to 150,000 pounds per square inch of pressure, the intensifier ratio and the drive pressure limited the system to 100,000 pounds per square inch maximum pressure. In this system the test item was enclosed in a heavy-walled tank to contain shrapnel in the event of failure.

A second stress analysis system was activated by helium gas and produced 30,000 pounds per square inch of pressure. A compressor located outside the building supplied the pressure. The helium gas test system was equipped with four sets of controls connected to a clam shell-type pressure chamber. Special electronic devices monitored these tests. Both of the previously mentioned pressure systems operated from a console separated from the test area by a cement block wall.

A third stress analysis test system used a clam shell-type chamber housed inside a glove box. The chamber was opened and closed hydraulically. Helium gas was used in this system.

The tensile strength of fissile weapons components was tested to evaluate material and weld-joint strength. The tensile strength and quality of non-fissile components such as rubber and plastic materials were also evaluated. There were two 60,000-pound-force tensile testers and one 20,000-pound-force, high-elongation tensile tester. One of the larger machines was enclosed in a glove box to provide capability for testing fissile material specimens.

Vibration analysis was conducted to evaluate component and waste container response to simulated seismic vibration and production-related resonant frequencies. Vibration analysis was conducted on a shaker unit. The shaker unit had a capacity of 17,500 foot-pounds of energy stimulated by a solid-state amplifier.

A gravity-inducing machine evaluated component response to situations of varying gravimetric force.

Disassembly Operations

Processing of site returns in Building 776/777 began in 1958, and continued after the 1969 fire. Processes consisted of disassembly, recovery, and waste disposal. Fissile materials (plutonium, uranium, etc.) and rare materials (beryllium) were recovered for reuse, and the remainder was disposed of. Increased weapons disassembly activities began in the late 1960s as older weapon designs were retired.

The disassembly process consisted of machining away the closure weld and separating and cutting the various weapon components for recovery of materials from a returned weapon. The weld machining operation was conducted in a B-box, (a hood-like enclosure with separate ventilation and fire protection) while wearing a respiratior. Disassembly and separation of the sub-components of a weapon were completed in glove boxes. The disassembly process used two lathes inside glove boxes with an inert argon atmosphere; one for beryllium components, the other for aluminum and stainless steel. A tritium gettering (removal) system was used to entrap tritium gases, water vapor, and hydrocarbon fumes that were released during disassembly. The inert atmosphere in the glove box minimized oxygen and moisture content. Several tritium monitoring and alarm devices checked tritium levels in the glove boxes, room air, and exhaust ducts. Sub-components were further reduced in size in a standard glove box system. Plutonium parts recovered from the disassembly process were inspected for unusual conditions and segregated according to material type. Enriched uranium parts went to Building 881 for recovery, and depleted uranium and inert components were packaged for disposal at off-site disposal sites.

After segregation, plutonium materials were returned to the Building 776/777 foundry where they were cast into feed ingots. Depending on assay specifications, the feed ingot was sent through a molten salt extraction process for americium removal, or was sent to Building 771 for chemical purification and returned to the foundry as a fresh button.

Recovery Operations

Several recovery operations were conducted in conjunction with fabrication operations in Building 776/777. A briquetting process recovered alloyed scrap from rejected parts, scrap from the center process line, and alloyed turnings into briquettes, which were then recast directly into ingots. The briquetting operations were conducted in glove boxes on the north and south briquetting presses located toward the center of the building.

There were two primary pyrochemical processes for recovery and purification of plutonium: electrorefining and molten salt extraction. Other refining processes included direct oxide reduction and salt scrub processes. Aqueous recovery of plutonium was not conducted in Building 776/777.

In the initial step of the pyrochemical recovery process, plutonium components from site returns were reduced in size using a pneumatic sizer. These re-sized components were then transferred to one of the following purification processes.

Electrorefining, an *in-situ* process developed in the 1960s, purified plutonium that did not meet purity specifications. Six production-scale electric furnaces were installed in Building 776/777 in 1966 to conduct electrorefining. The process was discontinued by the late 1970s due to low yields, but was restarted in the building in 1988. The electrorefining process used in the 1980s purified plutonium metal by placing it in a magnesium crucible with magnesium, sodium, and potassium chloride salts. An electric furnace was used to heat the mixture, and a cathode and anode stirrer were added to generate a reaction which resulted in pure plutonium metal, salts (magnesium, sodium, and potassium) and an anode heel. An anode alloy sub-process was used to produce an alloy that was subject to further recovery operations at the Savannah River site.

The molten salt extraction process removed americium, a decay byproduct, from plutonium metal, increasing the purity of the plutonium. Six furnaces were installed in Building 776/777 in 1972. This process used an electric furnace to heat plutonium metal combined with oxidant and solvent salts. The process produced purified plutonium and contaminated chloride salts. Americium chloride and plutonium chloride salts were removed from the contaminated salt in a process referred to as the salt scrub process. If the plutonium metal was not pure enough, it was subsequently subjected to the electrorefining process.

The salt scrub process used residue salts, such as those generated in the molten salt extraction process, to generate a metal alloy that was sent to the Savannah River site for further recovery. This process concentrated actinide metals into a metal alloy. There were three separate salt scrub processes used in Building 776/777. The first used a magnesium/zinc extractant in a tilt-pour furnace. The second used aluminum and magnesium as the alloying agent and the reductant, respectively. The last used gallium as the alloying agent, and calcium as the reductant.

Research began on the direct oxide reduction process in 1967. Without using aqueous processing, direct oxide reduction processes produced plutonium metal from plutonium oxide, and eliminated a potentially high-exposure hydrofluorination step used in the Building 771 plutonium recovery process. Pilot-scale operations were conducted from 1981 to 1983 and production-scale operations began in 1983. Plutonium oxide was batch-processed through a high-temperature calciner to remove moisture and drive off volatile compounds, resulting in a button of pure plutonium metal, calcium metal, and calcium chloride salts. If the button did not meet purity standards it was subsequently subjected to the electrorefining process.

Special Projects

After the 1969 fire, production-related activities shifted from full-scale production to research and development and special order work. This included research and development on joining technology and special coatings, and special assembly operations.

Joining Technology

Research and development on joining technology developed and maintained welding systems for product development and special order work. These systems joined non-fissile parts, components, and subassemblies. Over the years, these systems included a pressurized inert-gas metal-arc system, an electron beam system, and two types of laser welders. One of the lasers was used to cut and weld non-nuclear metal parts. The other welded non-production parts using compressed gasses. The electron beam system involved welding in a vacuum chamber in a glove box. In addition to these systems, solid-state bonding equipment was used for low temperature joining operations.

Coatings

There were two operations associated with coating research and development. One was concerned with the development of coatings for ceramic and non-plutonium substrates (sub-layer pieces); the other was concerned with the development of substrates to be coated with plutonium. These two operations were located in sections 776 and 777, respectively, of Building 776/777.

The section 776 operation researched the suitability of many elements and compounds for use as coating agents. Rare earth oxides and nitrates, chromates, manganese, and stainless steel were among those compounds and materials investigated. The operation also investigated optimal substrate preparation.

The section 777 operation developed substrates for plutonium coating, and researched optimal substrate preparation requirements. These operations were conducted in glove boxes with an inert nitrogen gas atmosphere.

Special Assembly

Special assembly operations included machining, inspection, assembly, and analysis of special items for off-site weapons design laboratories and on-site departments. These special items were for research and engineering purposes, pre-production components, or one-of-a-kind assemblies made of a range of metals and other materials. Tooling and fixturing were developed to meet unique requirements.

Waste Handling Operations

Waste handling operations included routine handling, processing, packaging of low-level radioactive waste, size reduction, fluidized-bed incineration, and drum storage.

Size Reduction

In the size-reduction operation, contaminated metals and materials were manually washed, cut up, and compressed to recover plutonium, reduce the size of materials, and minimize total volume of wastes. Discarded glove box gloves were washed to recover most of the plutonium, then placed in drums. Plutonium-contaminated metals were cut to a disposable size, washed to reduce contamination, and placed in drums or waste boxes for shipment to approved off-site locations. Shipping containers from the size-reduction operation were sent through drum or crate radiation counters for disposition.

Sludge from size-reduction operations that contained recoverable amounts of plutonium was dried and placed in containers to await recovery of plutonium. Used processing liquids were stored outside the size-reduction areas in tanks containing Raschig® rings or in safe-geometry tanks to prevent criticality events. Tank contents were sampled, and if the plutonium content was below predetermined limits, the liquid was pumped to the waste treatment facility. If not, it was sent to plutonium recovery in Building 771.

The advanced size reduction facility was used to disassemble or cut plutonium-contaminated glove boxes and miscellaneous large equipment down to an easily packaged size. The advanced size reduction facility process consisted of five sub-processes enclosed in one glove box, including an air-lock manual disassembly area, a remote disassembly area, a cutting area, a steam cleaning area, and a packaging area. In the advanced size reduction facility routine operations were performed remotely, using hoists, manipulator arms, and glove ports to reduce both intensity and time of radiation exposure to the operator. This facility included a separate exhaust-ventilation system, additional electrical power, fire protection, and alarm systems. The advanced size reduction facility ceased operations when production of weapons components at the Plant was curtailed in 1989.

Fluidized Bed Unit Incinerator

Building 776 contained two separate fluidized bed unit incineration processes: the pilot plant and the demonstration plant. The fluidized bed unit was designed to thermally treat low-level radioactive and mixed hazardous waste (liquid and solid). In both plants, process equipment was similar in design, but the demonstration plant had approximately nine times greater capacity.

The entire fluidized bed unit operation took place in a canyon and glove box system to contain radioactive contamination. A canyon was a processing room designed for eventual contamination; it contained no glove boxes. The waste passed from the canyon through an airlock into a glove box where scrap metal was manually removed. Combustibles and small, undetected scrap metal pieces were shredded, air-separated for further metal removal, and re-shredded prior to entering the primary fluidized bed unit for incineration. Emissions from the unit passed through an after-burner, a cyclone separator, and a bank of pre-filters and high-efficiency particulate air filters.

Operations Since 1989

Following a raid by the Federal Bureau of Investigation in 1989, production at the Plant was curtailed. In 1992, the mission of the Plant was officially changed from weapons components production to environmental restoration and waste management. After 1992, the major operations in Building 776/777 were waste handling and storage.

Sources:

Buffer, Patricia. 1995. "Highlights in Rocky Flats History". Rocky Flats Repository. Golden, Colorado.

Colorado Department of Health. *Project Tasks 3 & 4 Final Draft Report. Reconstruction of Historical Rocky Flats Operations and Identification of Release Points (1992),* by ChemRisk. Rocky Flats Repository. Golden, Colorado.

United States Department of Energy. *Historical Release Report (HRR) (1994),* by EG&G. Rocky Flats Plant Repository. Golden, Colorado, 1994.

United States Department of Energy. *Mission Transition Program Management Plan, Site Support Facilities Element. Appendix A-1, A-2, A-3, A-5 Revision 7, A-4 Revision 4 (1992),* by EG&G. Rocky Flats Plant Repository, Golden, Colorado, 1992.

United States Department of Energy. *Press Release: May 11, 1969 Fire (November 1985),* by Rockwell International. Rocky Flats Repository. Golden, Colorado, 1985.

United States Department of Energy. *Site Safety Analysis Report, Building 776/777.* Rocky Flats Repository. Golden, Colorado, 1987.

United States Department of Energy. *Final Cultural Resources Survey Report (1995),* by Science Applications International Corporation. Rocky Flats Repository. Golden, Colorado, 1995.